ON05237 PROJECT REPORT 92-07235/

Progress Report: _____ Final Report: X Project Number: 81-3205

Small-Scale: X Large-Scale: _____ Funding Year: 1987-88 (Year 23)

Transfer Grant: _____ (Priority: _____) OISE: X

New: X Continuing: _____ Terminated: _____ Re-funded: _____

Project Title: Implementation of Thinking Skills in the Junior Division

Investigator(s): Dr. John A. Ross

Budget Unit: Trent Valley Centre/FS&R Date Rec'd in FS&R: Jan 29/88

Project Objectives

1. To improve the quality of children's thinking.
2. To develop and support curriculum improvement teams.
3. To field test the effectiveness of two implementation strategies.

Project Report

One of the strategies for promoting change most frequently used by school boards is based on a social processing factor: Instead of providing inservice to all the target teachers directly, inservice is provided to a representative from each school with the expectation that this teacher will deliver the inservice to others in the local setting. The idea is that teachers will engage in extended discussions of the specifics of classroom practice which will enhance the use of the innovation. There is considerable controversy as to whether this indirect method is more effective--although there is no doubt that it can be considerably cheaper. Debates on the relative merits of all teacher versus key teacher strategies frequently occur in professional development day committees of teachers and in implementation meetings of senior administrators. Each approach has its enthusiastic adherents. What is missing from these debates is data about effects on students; the research literature contains no studies which might guide practitioners in their planning.

The purpose of the research reported here was to investigate the student achievement effects of the key teacher and all teacher strategies for delivering inservice. The focus of the inservice concerned a set of grade 4 social studies materials that emphasized children's thinking. Previous field tests indicated that student mastery of comparative and decision making problems improved dramatically when these materials were used with supportive inservice.

The study was conducted in a large school system in central Ontario with a commitment to planned change. In the first trial, 19 schools were randomly assigned to the two treatments. In the replication, 26 schools were randomly assigned. The two trials were identical except for the way in which release time was allocated. Pre and post tests of problem solving skills were administered.

The results showed that (a) there were high levels of noncompliance with the request for student data; (b) the key teacher method had no greater effect on student achievement than the all teacher strategy, and (c) teachers in both conditions preferred the all teacher treatment.

Noncompliance was attributed to the nature of the tests, teacher expectations and characteristics of the school system culture. The ineffectiveness of the key teacher method was attributed to the use of weak coaching strategies and a lack of support within the school for coaching activities.

Appendix 1: Draft of Article, June 1988

STUDENT ACHIEVEMENT EFFECTS OF THE KEY TEACHER METHOD OF DELIVERING INSERVICE

John A. Ross
OISE Trent Valley Centre

School systems employ a variety of mechanisms for delivering inservice. Among the most interesting is the key teacher strategy. Instead of providing inservice to all the target teachers directly, inservice is provided to a representative from each school with the expectation that this teacher will pass the message on to others. In the typical application the key teachers are released from classroom duties to undergo special training. The release time is often viewed as partial compensation for the task of training others in the school.

Supporters of the key teacher approach offer a twofold rationale. The first is cost: it is generally less expensive to train representatives than the entire population. The second is more substantive: it is argued that teachers are more likely to implement the desired practices if they talk about their instructional practices as required by the "passing on the message" component of the key teacher strategy.

Evidence in support of the key teacher approach is almost entirely anecdotal. But there is some research basis for claims about the value of teacher interaction in inservice. One body of evidence comes from studies of school innovation. For example, Louis & Dentler (1988), in a review of 12 state and regional school improvement projects, found that talking about the innovation played a key role in implementation and adoption decisions: Social processing was a major mechanism through which local educators tested the value of proposed programs in the local setting. In addition it stimulated local adaptation and facilitated the development of local commitment. Little (1982) found that continuous teacher talk which was concrete and precise had a beneficial effect. Frequent talk was associated with productive classroom experimenting; similar findings were obtained by Rosenholtz (1985). Fullan (1979, 1981), in synthesizing several reviews of the inservice literature, concluded that teachers learned from teachers more than from other agents in the school system. Bennett (1987) provided a quantitative measure of the social interaction variable: In a meta-analysis of 112 controlled studies of the effects of inservice on teachers she found that inservice that contained an inschool coaching component had a substantially greater impact on teachers, particularly in terms of the transfer of skills to new contexts. Similar findings have also been obtained in studies using more qualitative methodolgies. For example, Clark (1988) has reported that colleagial reflection on teaching practices is a major contributor to teacher change.

If implementation is viewed as a learning process, research on the links between student-student communication and achievement can provide further support for claims about the value of social interaction in inservice. A number of investigators have found that student achievement improves when children help each other with learning tasks. Some patterns of communication are more effective than others. For example, giving explanations to other students is strongly associated with higher achievement (Peterson, Janicki & Swing, 1981; Swing & Peterson, 1984; Webb, 1982; Webb & Cullian, 1983; Webb, Ender & Lewis, 1986). In contrast sheer frequency of communication is often found to be unrelated to achievement (Lyons, 1984; Moust, Schmidt, deVolder, Belien & deGrave, 1987). What matters is that the student talk involve learning processes. By talking to one another, students rehearse the material, obtain feedback on their understanding, receive information they may lack and, in describing and

explaining it to others, restructure it. These learning processes likely play a similar role in accounting for the effects of teacher-teacher communication on teacher change.

There is also evidence that the frequency and quality of student-student communication can be manipulated by placing students in mixed ability groups in which they must help each other with a learning task. A series of integrated reviews (Johnson, Maruyama, Johnson, Nelson & Skon, 1981; Michaels, 1977; Rolheiser-Bennett, 1986; Sharan, 1980; Slavin, 1980a, 1983) show that providing instruction to children in planned cooperative settings substantially contributes to the achievement of cognitive and social objectives. Ross & Raphael (forthcoming) found that although it was desirable to be very structured in defining the ends of the learning task, higher achievement in complex learning tasks was associated with medium structure in the means. Student groups that were given detailed procedures governing student-student communication underperformed students who were in groups that were permitted to develop their own procedures. The implication of this finding for attempts to improve teacher learning through teacher-teacher communication, is that prespecification of coaching procedures might be counterproductive--there have been no studies that have systematically varied coaching procedures.

Despite the research evidence that indirectly supports the claims of the key teacher method of inservice, and the wealth of testimonials from practitioners, no study has examined the student achievement effects of the method. The purpose of the research reported here was to investigate the student achievement effects of the key teacher method for delivering inservice in comparison with an all teacher strategy, (in which inservice is given directly to all the target teachers). Since cost is typically part of the rationale for the key teacher method, the student achievement effects will be investigated in two conditions of cost.

Method

The study was conducted in a large school system in Ontario with a commitment to planned change. Principals in the eastern area of the Board were invited to participate in the project in the fall of 1987; 19 principals volunteered their schools. These schools were randomly assigned to the two inservice treatments such that 10 schools (containing 24 grade 4 classes) were in the key teacher group; 9 schools (containing 20 grade 4 classes) were in the all teacher group. There was no untreated control group.

Treatments

1. The **all teacher method** consisted of three after school sessions for all grade 4 teachers. The first session followed a theory-practice-feedback sequence. The theory portion began with a rationale for giving more instructional attention to student acquisition of cognitive skills. Student growth to be accomplished through the program was described and an example of a lesson was demonstrated. Instruments for measuring student growth in cognitive skills were explained. Teachers were given short activities after each theory element to consolidate their understanding. Feedback on the consolidation tasks was addressed by distributing exemplary responses to the teacher exercises. At the end of the session detailed instructional materials (two social studies units each requiring 30-40 minutes per day for 5 weeks) were distributed, along with testing materials, a short manual providing an overview of the first inservice session and suggested timelines. The instructional materials stimulated the acquisition of selected problem solving skills: the ability to find similarities and differences on the basis of overt categories (comparison) and selecting the best course of action on the basis of overt criteria (decision making).

The instructional procedure represented in the units encouraged teachers to: (a) have students perform the target skill; (b) display the lowest level of performance; (c) demonstrate the inadequacies of the lowest level; (d) stimulate students to invent a higher peformance, and (e) consolidate the new level through a series of student worksheets to be completed individually. Weekly quizzes and student feedback forms were included in the packages. The

rationale for the instructional procedure is elaborated in Robinson, Ross & White (1985). Previous investigations have found that it has positive effects on problem solving achievement, (see, for example, the meta-analysis in Ross & Maynes, 1983), and that these effects tend to endure (Ross & Maynes, 1985).

The second session, held one month later, provided teachers with an opportunity to identify positive and negative experiences with the units. Both sets of responses were collected and displayed. Teachers were stimulated to invent strategies for resolving problems that had arisen. One month after the second session each teacher was contacted by telephone to discuss progress throught the units. The third session was held four months after the beginning of the project. It consisted of student data collection, feedback from teachers on their experiences and planning for the next year. The inservice activities for teachers in the all teacher condition were virtually identical to activities and materials field tested earlier with a much smaller sample. This study found that the average student in the treatment group outperformed 98% of the students in a control group given traditional instruction (Ross, in press).

Librarians and principals were encouraged to attend the teacher inservice sessions, although only a few principals continued beyond the first session. Principals and librarians were given ongoing tasks in support of teacher change.

2. The **key teacher inservice method** was identical to the all teacher method except that (a) only one grade 4 teacher from each school (selected by the principal) received the inservice directly, (b) release time (1.5 days) was given to each key teacher to attend the sessions, and (c) the key teachers were expected to pass the inservice on to other grade 4 teachers in cooperation with the school librarian and principal. The same theory-practice-feedback format was followed in the initial session, the instructional materials that were distributed were identical and the same follow up procedures were implemented.

Librarians in the key teacher schools were given release time to attend the three sessions. Principals were also invited to attend, although few continued beyond the first session, as in the all teacher treatment. Principals and librarians were given ongoing tasks in support of teacher change; these tasks were to be accomplished over the four month period through the mechanism of a curriculum improvement committee in the school. This committee was to consist of the key teacher, the librarian and the principal. The specific tasks of the curriculum improvement committee were clustered in three areas: enlisting teacher motivation for the change, providing resources in the form of materials and inservice, and monitoring the effects of the implementation effort on students and teachers. Following the findings of Ross & Raphael (forthcoming) that the effects of cooperative learning are maximized when there is high structure in defining what is to be learned and medium structure in how this learning is to occur, detailed procedures for governing the interaction between teachers were not prescribed.

Student Achievement Instruments

Teachers administered a pretest immediately following the first inservice session and a posttest at the conclusion of instruction. The tests consisted of an open ended item on comparison (e.g., "Compare two sports.") and a similar item on decision making (e.g., "Suppose your class is going on a school trip. How should the class decide where to go?"). There were two versions of each item which were rotated through the sample in a balanced design. All items were marked by a single trained marker using the schemes in Figure 1.

Figure 1 About Here

Replication

The study was replicated in the January term of 1988 in the western area of the same Board. Principals from 26 schools volunteered to participate and their schools were randomly assigned to the two treatments, such that 12 schools (containing 29 grade 4 classes) were in the key teacher method and 10 schools (containing 24 grade 4 classes) were in the all teacher

method.[2] The two inservice treatments in the January period were identical to those in the fall except that the amount of release time was equally distributed between the two inservice conditions--all participants were given 1.0 days of release time and the middle session was held after school.

Analysis

The analysis was a multivariate analyis of variance. There were two dependent measures: comparison (scored 0-5) and decision making (scored 0-7). Multivariate effects were tested by examing Wilk's F-test; univariate effects were also examined. The pretest score was the covariate. Treatment (key teacher versus all teacher) and release time condition (unequal versus equal) were grouping factors; these factors were crossed. The unit of analysis was the class; school was a nested factor. The main output was produced by the MANOVA program of SPSS-X, version 2.2, run on a DEC VAX.

Results

Three interesting findings emerged from the study: First, there were high levels of noncompliance with the request for student data. Only 62% of the target teachers over both time periods (63 of 102 classes) submitted complete data sets for their students. Participation was slightly higher in the all teacher than in the key teacher method (66% versus 58%). Within the key teacher sample, those designated as key teachers were more likely to participate fully than the remaining teachers in the schools (75% to 45%).

The second interesting finding was that the key teacher strategy did not have the anticipated effect. Student achievement results for the classes that did submit data are displayed in Table 1. Student gains from pre to post were substantial: .82 standard deviations for comparison and 2.51 standard deviations for decision making. There were no significant multivariate or univariate effects for inservice method. There were also no effects for release time condition, nor were there method-time interactions. There was a significant univariate effect for school on the decision making measure only [$F(11, 48)=2.31$, $p<.023$].

Table 1 About Here

The third finding was that teachers in both conditions expressed a strong preference for the all teacher method. Those in the key teacher treatment reported feeling unrewarded and unprepared for the task of delivering inservice to others.

Discussion

The teachers who did not submit student data did not view themselves as nonparticipants. The majority attended all the inservice sessions, including the ones held after school, although the sessions held during the school day were better attended. Some attempted to implement the instructional materials relatively faithfully but did not feel obliged to administer the achievement tests. Others used fragments of the materials or adapted them to other contexts. The remainder made no attempt to change their instructional practices.

Noncompliance with the testing requirements was the outcome of many factors, the most important being (a) the nature of the tests, (b) the expectations of teachers and (c) the culture of the school system. These factors affected both inservice treatments; variable implementation was the norm in each.

(a) Testing: The student achievement tests used to measure the effects of instruction were more difficult than the quizzes and student exercises contained in the units. The quizzes provided students with much of the content information that would be required to perform the

skill. For example, students might be given information about a variety of buildings and be asked to decide which type of building would be most appropriate for a tropical rainforest. To complete the task, students had to identify alternatives and criteria embedded within the information provided in the stimulus portion of the task. The quizzes in the unit were in one sense closer to the skill tests developed by teachers: Doyle & Carter (1984) and Sanford (1985) have reported that teacher tests of complex cognitive objectives provide "safety nets" to help children from failing, for example, by having the higher level components count less than recall or procedural elements. The quizzes in the units provided a measure of the skills but it was diluted--the marking scheme awarded the bulk of the grade for content reiteration. It was possible for students to do reasonably well on these quizzes even if their grasp of the skill demands was minimal.

In contrast the pre and post tests provided few safety nets. They used familiar situations but provided very little information that could be used in performing the skill. For example, students might be asked to decide how to celebrate a school centenary. To complete the task they would have to generate alternatives and criteria but none of this information was provided by the stimulus portion of the item. Teachers were aware that the pre/post tests were more difficult than the tasks of the unit and in the interviews several indicated that they did not administer the tests because they didn't think it would be fair. Few recalled the brief statement in the first inservice session that this item type was chosen for pre/post measurement because of its greater discrimination.

(b) Teacher Expectations: Student skill growth was represented in the inservice as a hierarchy of increasingly sophisticated levels of performance. Teachers found this idea attractive and agreed that although most grade 4 students would be at the lower levels on entry to the program there would be a great deal of individual variation. Many teachers expressed surprise that student performance continued to vary after instruction--in most classes the range increased as the more able students started at higher levels and learned more rapidly than the less able. Most teachers also underestimated the amount of overt practice on the skill required to improve performance. Those who administered only a few of the exercises, selected on the basis of their superficial features such as congruence with content plans and perceived motivational appeal, found that students as a group improved much more slowly than anticipated and many appeared not to improve at all. Teachers expected that virtually all students would be functioning at the upper levels of the skill growth schemes and in some classes this occurred. When it became clear in others that this expectation would not be met, many teachers shelved their testing plans.

(c) School System Culture: Neither of the preceding factors would have made a difference in the absence of certain attitudes and beliefs about inservice and testing existing in the Board. The senior administration had a strong commitment to inservice as an extended process of input followed by classroom implementation. They believed that redundant encounters with the material to be learned and ample classroom practice were essential to lasting teacher change. This commitment represented a change in system thinking that was not institutionalized. A substantial proportion of the grade 4 teachers believed that inservice consisted of one shot "awareness" sessions. Teachers reported that attendence at a given inservice session was typically voluntary on the part of the teacher or the school. It would not be unusual to attend a second session on the same theme that was virtually identical to the first because those organizing the workshop felt they had to assume no prior knowledge on the part of those attending. Follow up at the school level was rare and timelines for putting new practices into use were typically vague. Consequently many teachers believed it was acceptable to respond to the inservice with partial implementation and ignore the testing requests completely.

The senior administration also had a strong set of beliefs about the role of the principal as curriculum manager and the librarian as the partner of teachers in curriculum planning. These beliefs were not widely shared within the system. Consequently the support that teachers received from these agents varied widely.

Beliefs about the relationship between testing and inservice also had an influence. At the highest administrative levels there was some support for the view that student achievement

should provide the final measure of the effects of inservice but most teachers saw the testing programs operating in the Board as quite separate. The familiar methods for assessing teacher development activities were largely summative satisfaction measures and less commonly self reported changes in teaching practices. References to changes in student perfomance were infrequently introduced as a criterion for appraising inservice activities. Many teachers thought their anecdotal comments about their experiences with the units were the important data; the purpose for the student testing seemed obscure.

Finally, there were significant communication problems. For example, many teachers in the January term thought they were supposed to start in the fall and did so, (hence the higher pretest scores of the January group), even thought the inservice team sent three written messages to the contrary. These communication problems provided an acceptable rationale for those who declined to participate in the testing component.

Why were the student achievement effects not higher in the key teacher inservice method? Interviews with the key teachers provided little information about the processes that went on, mainly because teacher-teacher communication on curriculum issues tended to be infrequent and brief. The curriculum improvement teams did not function as intended; most never met. Communication tended to be ad hoc rather than planned.

Weak coaching strategies predominated. Most key teachers reported that they distributed the units and tests to the other grade 4 teachers and asked them to use the material. Little attention was given to teacher motivation, although some provided testimonials about their own positive experiences. Discussions centred on the activities section of the material; there were few references to the theoretical sections of the inservice--the expected student growth, the generic instructional procedure or the methods for assessing student performance. Although some key teachers reported joint planning and delivery of lessons, the majority encouraged the other teachers to implement the material on their own. In most instances there were few attempts to find out how the other teachers made out, but once again there were a few key teachers who were able to arrange classroom visits to demonstrate and provide feedback.

Although most key teachers tried to enlist the participation of other teachers in the school, they were not as a group persistent. Those who did not follow up reported a lack of rewards in the system for helping others in their school, the existence of disincentives (e.g., violations of norms of classroom privacy), a lack of support from the principal (e.g., an unwillingness to cover a class so that teachers could observe each other), and a feeling that the key teacher herself/himself lacked the appropriate consultancy skills to assist others.

Implications

The findings do not support the use of the key teacher strategy as operationalized in this study. Student achievement results were no better than those obtained with a method in which inservice was delivered to all teachers directly and there was evidence that teachers preferred the all teacher method.

Supporters of the key teacher method might redraw their claims on the basis of these findings. It might be argued that the key teacher strategy will have the desired effect only under certain conditions. Some of these conditions would apply to any inservice method; for example, inservice is more likely to be successful when the efforts of internal agents (principals, consultants, etc.) are tightly rather than loosely coupled. Others, such as norms of collegiality, might have a differential impact within the key teacher method. The most easily controlled of these latter factors are procedures for teacher-teacher communication. In this study little direction was given to key teachers in terms of how they should approach the other teachers in the school, the strategies they might use for passing on the message and the mechanisms within the school for monitoring the coaching process. In contrast detailed procedures are available elsewhere (e.g., Joyce & Showers, 1986, 1988). A productive line of inquiry would involve systematically varying the procedures given to key teachers to measure the effects of specific procedures and of procedural detail on student achievement. An intermediate step might focus

on the effects of procedures on the actions of key teachers (e.g., measured with audio tapes of teacher-teacher communication) and on the extent to which these procedures contribute to teacher change.

Notes

1. The research was funded by the Ontario Institute for Studies in Education, grant 81-3205. The views expressed here are not necessarily those of the Institute. Susan Elgie contributed to the analysis of the data.

2. There were 28 schools (14 in each group) in the replication sample immediately after assignment. Two of the key teacher schools dropped out of the project just as it began.

References

Bennett, B. (1987). The effectiveness of staff development training practices: A meta-analysis. Ph.D. thesis, University of Oregon. [UMI 87-21226]

Clark, C. (1988). Asking the right questions about teacher preparation: Contributions of research on teacher thinking. *Educational Researcher, 17* (2), 5-12.

Doyle, W. & Carter, K. (1985). Academic tasks in classrooms. *Curriclum Inquiry, 14* (2), 129-149.

Fullan, M. (1979). School focused in-service education in Canada. Unpublished paper, OISE, Toronto.

Fullan, M. (1981). School district and school personnel in knowledge utilization. In R. Lehming & M. Kane (Eds) *Improving schools: Using what we know.* Beverly Hills, CA: Sage.

Fullan, M. (1982). The meaning of educational change. Toronto: OISE Press.

Fullan, M., Anderson, S. & Newton, E. (1986). *Support systems for implementing curriculum in school boards.* Toronto: Ontario Ministry of Education.

Johnson, D., Maruyama, G., Johnson, R., Nelson, D. & Skon, L. (1981). Effects of cooperative, competitive, and individualistic goal structures on achievement: A meta-analysis. *Psychological Bulletin, 89* (1), 47-62.

Joyce, B. & Showers, B. (1986). Peer coaching guides. Eugene, OR: Booksend Laboratories.

Joyce, B. & Showers, B. (1988). Student achievement through staff development. New York, NY: Longman.

Little, J. (1982). Norms of collegiality and experimentation: Workplace conditions of school success. *American Educational Research Journal, 19* (3), 325-340.

Michaels, J. (1977). Classroom reward structures, *Review of Educational Research, 47* (1), 87-98.

Moust, J., Schmidt, H., deVolder, M., Belien, J. & deGrave, W. (1987). Effects of verbal participation in small group discussion. In J. Richardson, M. Eysenck & D. Piper (Eds.), *Student learning: Research in education and cognitive psychology*, Milton Keynes: Open University.

Peterson, P., Janicki, T. & Swing, S. (1981). Ability X treatment interaction effects on children's learning in large and small group approaches. *American Educational Research Journal, 18* (4), 453-473.

Rolheiser-Bennett, N. (1986). Four models of teaching: A meta-analysis of student outcomes. Unpublished Ph.D. dissertation, University of Oregon. [UMI 87-05887]

Rosenholtz, S. (1985). Effective schools: Interpreting the evidence. *American Journal of Education, 93,* 352-388.

Robinson, F., Ross, J. & White, F. (1985). *Curriculum development for effective instruction.* Toronto: OISE Press.

Ross, J. & Maynes, F. (1983). Teaching problem solving: An instructional design strategy. *Canadian Journal of Education, 8* (2), 155-173.

Ross, J. & Maynes, F. (1985). Retention of problem solving performance in school contexts. *Canadian Journal of Education, 10*, (4), 383-401.

Ross, J. (in press). Improving social-environmental problem solving through cooperative learning. *American Educational Research Journal.*

Ross, J. & Raphael, D. (forthcoming). Student communication and problem solving achievement in cooperative learning groups of medium and high structure.

Sanford, J. (1985). Comprehension-level tasks in secondary classrooms. R&D Report #6199. Austin, TX: R&D Center for Teacher Education, University of Texas.

Sharan, S. (1980). Cooperative learning in small groups: Recent methods and effects of achievement, attitudes and ethnic relations. *Review of Educational Research, 50* (2), 241-272.

Slavin, R. (1980). Cooperative learning. *Review of Educational Research, 50*, (2), 315-342.

Slavin, R. (1983). When does cooperative learning increase student achievement. *Psychological Bulletin, 94* (3), 429-445.

Swing, S. & Peterson, P. (1982). The relationship of student ability and small group interaction to student achievement. *American Educational Research Journal, 19* (2), 259-274.

Webb, N. (1982). Student interaction and learning in small groups. *Review of Educational Research, 52* (3), 421-445.

Webb, N. & Cullian, L. (1983). Group interaction and achievement in small groups: Stability over time. *American Educational Research Journal, 20* (3), 411-423.

TABLE 1

MEANS AND STANDARD DEVIATIONS OF THE INSERVICE TREATMENTS

Release Time Condition	Treatment Condition	Number of Classes	Comparison Scores		Decision Making Scores	
			Pre	Post	Pre	Post
Unequal	Key Teacher	14	1.99 (0.94)	2.38 (0.87)	0.77 (0.20)	1.56 (1.12)
	All Teacher	14	1.86 (0.78)	2.75 (0.92)	0.80 (0.25)	2.67 (1.75)
Equal	Key Teacher	16	2.37 (0.82)	3.46 (1.04)	1.32 (0.59)	2.79 (1.38)
	All Teacher	18	3.08 (0.76)	3.74 (0.85)	1.59 (0.60)	3.21 (1.31)
Total Sample		62	2.37 (0.94)	3.14 (1.06)	1.16 (0.58)	2.62 (1.49)

Comparative Problems	Score
1. Matching information using implicit categories	
.information about each object of comparison will be developed and some of it will be matched	1 mark
.all of it will be matched	2 marks
2. Use of explicit categories to organize information	
.one explicit category used	1 mark
.more than one explicit category	2 marks
3. Interpreting comparisons	
.each comparison summarized as similar or different	1 mark
Decision-Making Problems	
1. Identification of alternatives	
.more than one explicit alternative	1 mark
2. Development of criteria	
.primitive strategy for deciding, e.g., voting	1 mark
.identification of explicit advantages	2 marks
.explicit advantages and disadvantages	3 marks
.one explicit criterion applied to all alternatives	4 marks
.more than one explicit criterion	5 marks
3. Summarizing information about values of alternatives	
.use of quantitative strategy, e.g., +'s and -'s	1 mark

Figure 1: Indicators of Problem Solving Skill